



LRFD

Section 3.72

New: January 2005

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3.72.1 General**1.1 Material Properties****Concrete**

Typically, shall consist of:

Class B Concrete (Substructure)

$$f'_c = 3.0 \text{ ksi}$$

$$n = 10$$

In addition, *Class B-1 Concrete (Substructure)* may also be used in special cases (See Project Manager). The following equations shall apply to both concrete classes:

LRFD 5.4.2.4

Concrete modulus of elasticity, $E_c = 33000 K_1 w_c^{1.5} \sqrt{f'_c}$

Where:

w_c = unit weight of non-reinforced concrete = 0.145 kcf

K_1 = correction factor for source of aggregate = 1.0

LRFD 5.4.2.6

Modulus of rupture: For minimum reinforcement, $f_r = 0.37 \sqrt{f'_c}$

For all other calculations, $f_r = 0.24 \sqrt{f'_c}$

$\sqrt{f'_c}$ is in units of ksi

Reinforcing Steel

Minimum yield strength,

$$f_y = 60.0 \text{ ksi}$$

LRFD 5.4.3.2

Steel modulus of elasticity,

$$E_s = 29000 \text{ ksi}$$

3.72.2 Design

2.1 Limit States and Factors

In general, each component shall satisfy the following equation:

LRFD 1.3.2.1

$$Q = \sum \eta_i \gamma_i Q_i \leq \phi R_n = R_r$$

Where:

Q = Total factored force effect

Q_i = Force effect

η_i = Load modifier

γ_i = Load factor

ϕ = Resistance factor

R_n = Nominal resistance

R_r = Factored resistance

LRFD 5.5

Limit States

The following limit states shall be considered for bent design:

STRENGTH – I

STRENGTH – III

STRENGTH – IV

STRENGTH – V

SERVICE – I

FATIGUE

See LRFD Table 3.4.1-1 and LRFD 3.4.2 for Loads and Load Factors applied at each given limit state.

Resistance factors

LRFD 5.5.4.2

STRENGTH limit states, see LRFD 5.5.4.2

LRFD 1.3.2.1

For all other limit states, $\phi = 1.00$

LRFD 1.3.2.1

Load Modifiers

For loads where a maximum value of load factor is appropriate:

$$\eta = (\eta_I \eta_R \eta_D) \geq 0.95$$

For loads where a minimum value of load factor is appropriate:

$$\eta = 1 / (\eta_I \eta_R \eta_D) \leq 1.0$$

Where:

LRFD 1.3.3

η_D = Factor relating to ductility

LRFD 1.3.4

η_R = Factor relating to redundancy

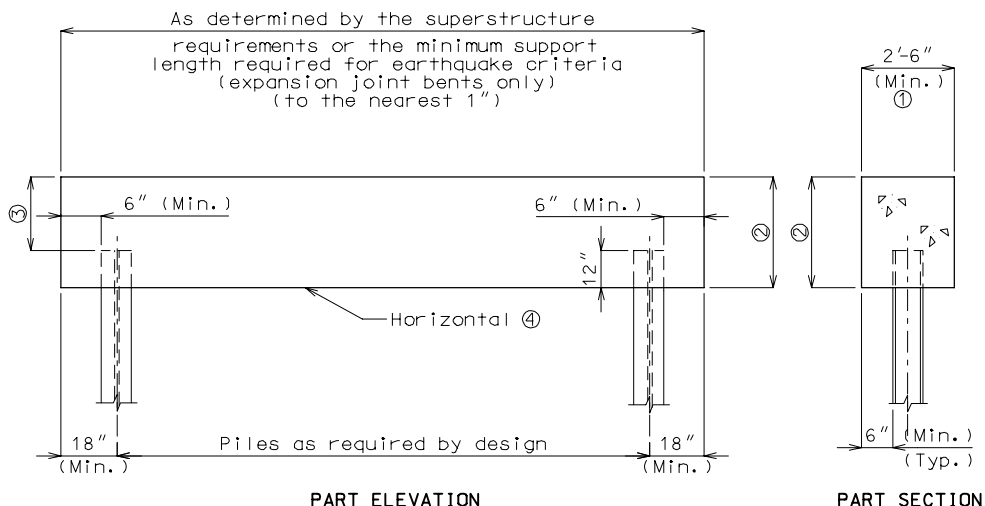
LRFD 1.3.5

η_I = Factor relating to operational importance

Table 3.72.2.1.1 Load modifiers

	All Limit States
Ductility, η_D	1.0
Redundancy, η_R	1.0
Operational importance, η_I	1.0
$\eta = (\eta_I \eta_R \eta_D)$	1.0
$\eta = 1 / (\eta_I \eta_R \eta_D)$	1.0

3.1 GENERAL

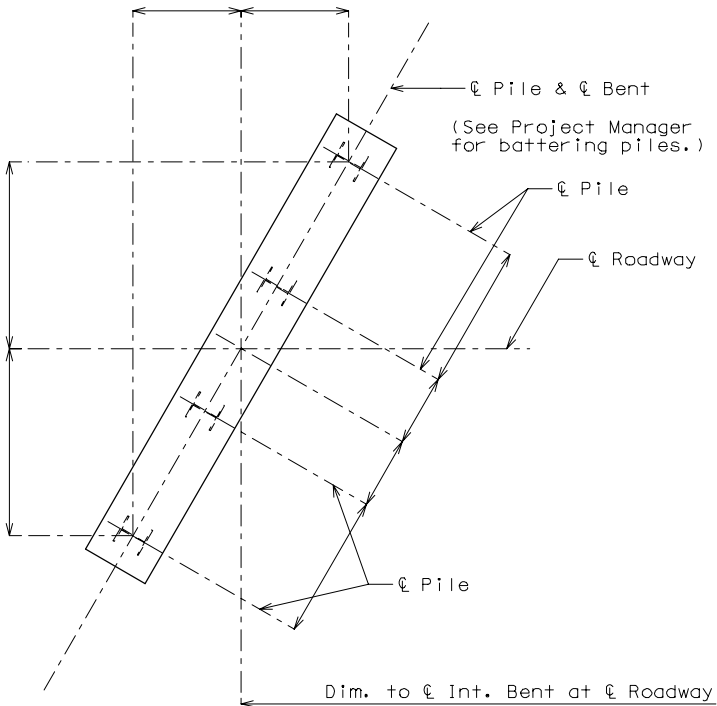


- ① Use 2'-6" minimum or as determined by the superstructure requirements or the minimum support length required for earthquake criteria (expansion joint bents only) (3" increments).
- ② = 2'-9" (Min.) for Wide Flange and Double-Tee Girders or, 3'-0" (Min.) for Prestressed Girders and Plate Girders.
- ③ Check the clearance of the anchor bolt well to the top of pile. Increase the beam depth if needed.
- ④ If the depth at the end of the beam, due to the steps, exceeds 4'-6", the beam bottom should be stepped or sloped.

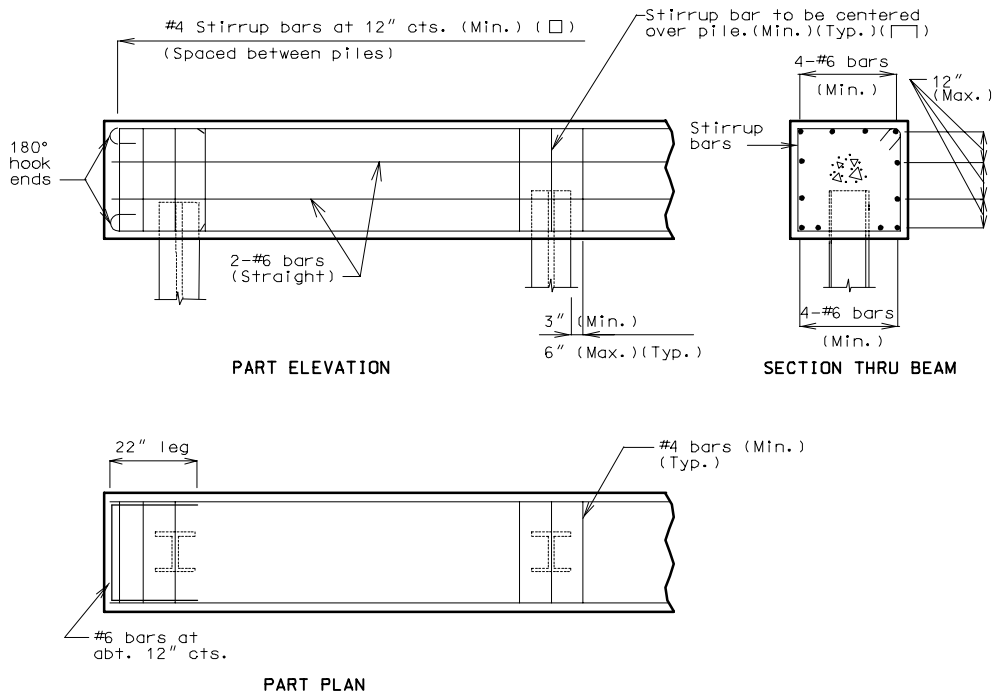
3.2 FRONT SHEET

Note: The following are details and dimensions for the Plan View on the Front Sheets.

Details for unsymmetrical roadways will require dimensions tying Centerline Lane to Centerline Structure.



4.1 GENERAL

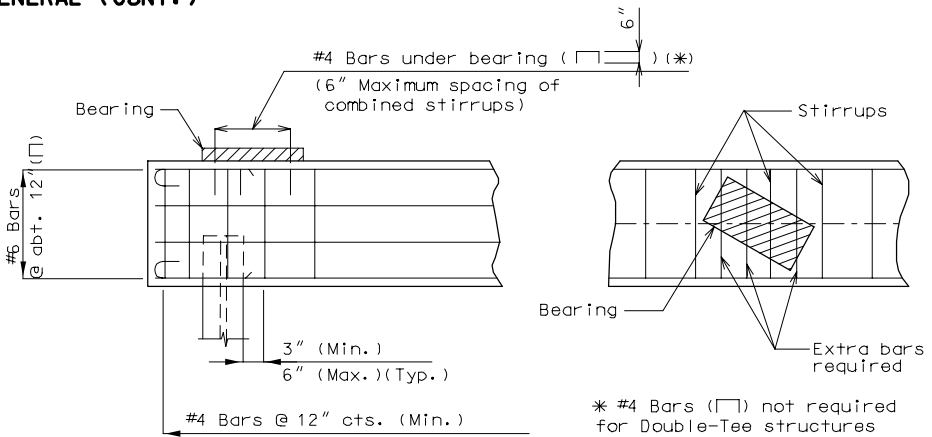


Note:

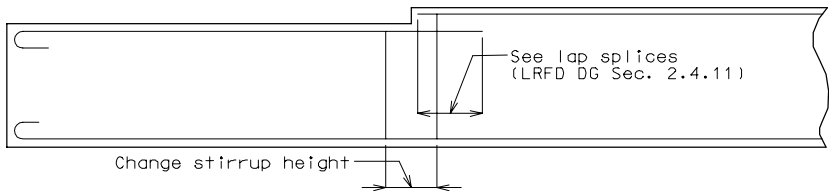
Locate #4 bars "□" under bearings where required to maintain a 6" maximum spacing of combined stirrups. (#4 bars "□" are not required for Double-Tee Structures.)

When an expansion device is used at an intermediate bent, all reinforcement located entirely within the beam or extending into the beam shall be epoxy coated.

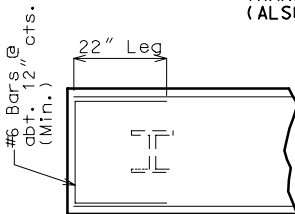
GENERAL (CONT.)



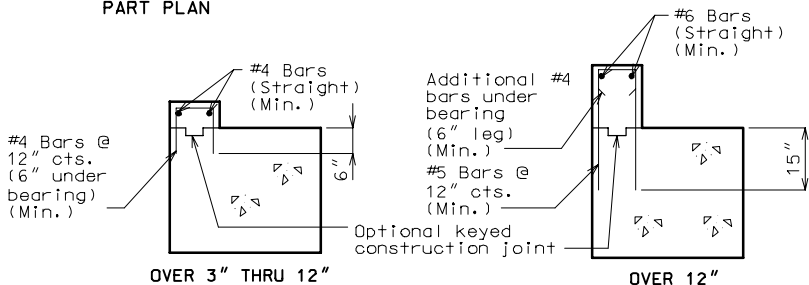
REINFORCEMENT UNDER BEARINGS



TRANSVERSE BEAM STEPS - OVER 3" (ALSO, STEPS ACCUMULATING OVER 3")



PART PLAN



LONGITUDINAL BEAM STEPS